Remarks

I. Summary of Amendments

The two paragraphs beginning at the bottom of page 2 and ending at the bottom of page 3 of the Specification have been amended to refer to the method steps shown in Figure 1.

Figure 1 has been amended to include the reference numbers cited in the amended paragraphs on pages 2 and 3 of the Specification and to include the figure label designation "(Prior Art)".

Figure 3 and the corresponding paragraphs inserted at page 29 have been added to clarify the section of the Specification entitled "A Lazy Coding Mode".

II. Status of Claims

Claims 1-10 and 12-18 remain in the application. Claims 1-10 correspond to claims 1-10 as originally filed in the parent application and claims 12-18 are new claims.

III. Response to Examiner's Rejections in Parent Application

In the parent application, the Examiner rejected claims 1-10 under 35 U.S.C. § 103(a) over the JPEG 2000 image compression system, as described in the background section of the application, in view of Schwartz (U.S. 5,815,097) and Budge (U.S. Patent Application No. 2002/0080408).

A. Independent claims 1 and 6

Independent claims 1 and 6 each requires transform coefficient data from at least one bit-plane not subjected to arithmetic coding to be included in an encoded bit-stream.

The Examiner has acknowledged that the JPEG 2000 image compression scheme "does not teach or suggest the feature that 'coefficient data from at least one bit-plane is included in the encoded bit-stream without arithmetic coding.'"

In the Office action dated May 27, 2003, in the parent application, the Examiner has indicated that:

> At first, the Examiner also cited in paper #4: "The passages in column 11, lines 37-53 and column 13, lines 12-32 teaches that data are passed to manager 1207 without arithmetic coding." The Applicant just ignored to respond to this citation.

The section of Schwartz' disclosure cited by the Examiner, however, relates to predictive coding in the image domain. This section of Schwartz does not teach or suggest anything about arithmetic coding of bit-planes of transform coefficient data, which is performed in the transform domain. The Examiner has assumed incorrectly that techniques that work well for image-domain predictive coding schemes can be applied directly to transform-domain arithmetic coding scheme. However, there is no teaching or suggestion in any of the cited references that would have led one of ordinary skill in the art at the time of the invention to implement an arithmetic-coding-based image compression method in which certain transform coefficient data from at least one bit-plane is included in an encoded bit-stream without arithmetic coding, as recited in claims 1 and 6. Indeed, none of the cited references provides any basis for one of ordinary skill in the art at the time of the invention to have believed that certain portions of certain bit-planes of transform coefficient data could be efficiently left un-coded in a bit-stream. Therefore, there would not have been any motivation for one of ordinary skill in the art at the time of the invention to have attempted to implement the method and system recited in claims 1 and 6, respectively.

In the parent application, the Examiner has further indicated that (original emphasis):

> Furthermore, the passage in column 9, lines 23-43 teaches: "First, bit-plane method require more context bins for the same compression, and assuming each context bin requires a predetermined number of bits of memory, then the memory for larger bit-planes context models has a high hardware cost. Second, in a bit-plane context module, every bit is entropy coded. Therefore, N-bit data requires N coding operations. ***For predictive coding data, some of the data can be assumed to be 50% random data and simply copied to/from the compressed data without needed entropy coding, thereby reducing the entropy coding operations and allowing hardware to operate at faster speeds."*** The Applicant also ignored the above highlighted part that provides a very strong motivation to bypass arithmetic coding in some situations.

In this argument, the Examiner has asserted that the teaching that in a predictive coding process some of the data can be copied to/from the compressed data without entropy coding "provides a very strong motivation to bypass arithmetic coding in some situations."

At the very least, however, this "motivation" does not apply to methods in which an encoded bit-stream is formed by coding bit-planes of transform coefficient data, as recited in claims 1 and 6. Indeed, Schwartz expressly teaches that among the differences between predictive coding and bit-plane coding is that (col. 9, lines 29-30):

> in a bit-plane context module, every bit is entropy coded. N-bit data requires N coding operations.

That is, Schwartz expressly teaches that in bit-plane coding "every bit is entropy coded." Accordingly, Schwartz teaches away from the bit-plane coding based method and system of claims 1 and 6, respectively, in which transform coefficient data from at least one bit-plane is included in an encoded bit-stream without arithmetic coding. It is improper for the Examiner to conclude that a reference provides a "very strong motivation to bypass arithmetic coding" in the context of bit-plane coding, when that reference expressly teaches away from such a conclusion.

In the parent application, the Examiner has further indicated that

> Fig. 12 discussed in column 11, lines 37-53 clearly teach that "coefficient data from at least one bit-plane is included in the encoded bit-stream without arithmetic coding." It is the coding of each bit plane in Schwartz's special prediction coding that teaches the advantage of passing data of some bit planes without arithmetic coding.

Once again, however, the Examiner has failed to distinguish between the bit-plane based coding method and system recited in claims 1 and 6, respectively, and the predictive coding process shown in FIG. 12 of Schwartz. As explained above, Schwartz expressly teaches away from the conclusion the Examiner has asserted.

With respect to Budge, the Examiner has indicated that:

> Budge teaches that k least significant bits of N-bit data are randomly distributed. (section 0065)
>
> It is desirable for reducing the entropy coding operations and allowing hardware to operate at faster speeds. It would have been obvious to one of ordinary skill in the art, at the time of the invention, to apply the teachings of Schwartz and Budge to bypass arithmetic coding of the K least significant bits-planes of the data taught in the admitted prior art, because the overall combination provides an advantage of reducing the entropy coding operations.

Budge's teaching in paragraph [0065], however, relates to coding of prediction errors in a predictive coding scheme. Budge's approach, in which certain bits are "un-coded," corresponds to a well-known prefix-free (e.g., Huffman code) coding technique called the Golomb-Rice code. In Budge, this coding scheme is used for a non-embedded symbol-by-symbol coding scheme, which is completely different from stream-like arithmetic coding schemes. Budge, like Schwartz, does not teach that coefficient data from at least one bit-plane is included in an encoded bit-stream without arithmetic coding. In addition, Schwartz's teaching that in bit-plane coding "every bit is entropy coded" is not contradicted by Budge. Accordingly, based on the combined teachings of Schwartz and Budge, one of ordinary skill in the art at the time of the invention would have entropy encoded the data from every bit-plane before assembling the final bit stream in a bit-plane context model based image compression implementation.

For at least the reasons explained above, the Examiner's rejection of independent claims 1 and 6 under 35 U.S.C. § 103(a) should be withdrawn.

B. Dependent claims 2-10

Claims 2-5 depend from independent claim 1 and claims 7-10 depend from independent claim 6. Therefore, these claims are patentable for at least the same reasons explained above.

With regard to the subject matter of dependent claims 4 and 9, in the parent application, the Examiner has asserted that the combination of Schwartz and Budge teaches that coefficient data from bit-planes $p<p_0-K$ are written directly into the encoded bit-stream without arithmetic coding, where $K=3$. In support of this assertion, the Examiner has indicated that:

> It is well known that a pixel usually has 8 bits. Therefore, the data used in the admitted prior art has 8 bit planes. Schwartz teaches in column 11, lines 21-27 that three or four entropy coding operations are performed on the amplitude data. Thus, the combination of the admitted prior art and Schwartz can include a case of K=3. If the data in either reference would not have more than 3 bits, then they cannot be combined to meet the requirement.

The relevance of 8-bit pixels to the subject matter of claims 4 and 9 is unclear. The number of bits in a bit-plane is determined by a number of factors, including the number bits per pixel in the original image and any transform or prediction that may be applied to the data. If no transform is applied then the number of bit-planes is simply the number of bits per pixel in the image. If a transform is applied, the dynamic range of some of the transform coefficients is usually larger than that of the pixels so a greater number of bit-planes is required. The precise number bit-planes depends on, for example, the transform, whether it is a lossy or lossless transform, and the particular band of the transform in the case of wavelets.

In any event, Schwartz's teaching that three or four entropy coding operations are needed to code magnitudes with a four bit number does not teach or suggest anything about writing transform coefficient data from certain bit-planes directly into an encoded bit stream without arithmetic coding, much less anything about writing coefficient data from bit-planes with significance levels below the three most significant bit-planes directly into the encoded bit stream without arithmetic coding.

Thus, for this additional reason, the Examiner's rejection of dependent claims 4 and 9 under 35 U.S.C. § 103(a) should be withdrawn.

IV. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 08-2025.

Respectfully submitted,

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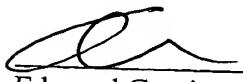

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